

LISTING OF CLAIMS

*Draft 3/31/05*

*This listing of the claims replaces all previous versions of the claims.*

1. **(Currently Amended)** A method of transmitting a downlink signal from a first communication station of a communication system to a remote communication device, the first communication station having a smart antenna system, the method comprising:

providing a first set of sequential time intervals for the first communication station, each of the time intervals having a selected number of downlink conventional channels, and an associated conventional channel on an uplink conventional channel associated with each of the downlink conventional channels, each associated uplink conventional channel having a predefined relationship to its associated downlink conventional channel;

providing one or more further sets of sequential time intervals, each set of the one or more further sets of sequential time intervals associated with one or more other communication stations of the communication system, the further sets of sequential time intervals for communication between the other communication stations and one or more other remote communication devices associated with the other communication stations;

receiving one or more uplink signals from one or more of the other, undesired remote communication devices as interference on one or more uplink channels associated with a first downlink conventional channel;

determining a downlink smart antenna processing strategy for transmitting from the first communication station in a non-directional manner on ~~a~~ the first downlink conventional channel, the strategy including mitigating interference towards the one or more other remote communication devices ~~known to the first communication station to be undesired to reduce, with respect to in that each of~~ the one or more undesired remote communication devices

devices, a strength of a signal transmitted may receive one or more signals on the first downlink conventional channel during transmitting by the first communication station on the first downlink conventional channel, the downlink processing strategy using the received uplink signals as inputs to provide interference mitigation; and

transmitting a downlink signal in a non-directional manner from the first communication station on the first downlink conventional channel using the determined downlink processing strategy.

2. (Original) A method as described in claim 1,

wherein the downlink signal is a paging signal to a first remote communication device of the first communication station,

wherein each remote communication device associated with the first communication station has an active state wherein it is in active communication with the first communication station, and an idle state wherein it has established its identity but is not actively communicating, and

wherein the first remote communication device is in an idle state during the transmitting step of the paging signal.

3. (Original) A method as described in claim 2, wherein the first remote communication device includes a second plurality of antenna elements.

4. (Original) A method as described in claim 3, wherein the first remote communication device includes a second smart antenna system that includes the second plurality of antenna elements.

5. (Original) A method as described in claim 2, wherein the first remote communication device includes a remote user terminals.

6. (Original) A method as described in claim 5, wherein at least one remote user terminal is mobile.

7. (Original) A method as described in claim 1, wherein the downlink signal is a broadcast signal to one or more remote communication devices of the first communication station, and

wherein the downlink strategy determining step determines a downlink smart antenna processing strategy for transmitting the downlink signal in a substantially omnidirectional manner except for simultaneously mitigating interference towards the undesired remote communication devices.

8. (Original) A method as described in claim 1, wherein the first communication station comprises a cellular base station.

9. (Original) A method as described in claim 1, wherein the first communication station is coupled to an external data and/or voice network.

10. (Original) A method as described in claim 9, wherein the external network includes the Internet.

11. (Canceled)

12. (Currently Amended) A method as described in ~~claim 11~~ claim 1, wherein the ~~communication system includes~~ one or more other communication stations, stations of the system are each associated with one or more of the further sets of sequential time intervals, and

wherein the one or more of the other, undesired remote communication devices include a remote communication device associated with the one or more other communication stations.

13. (Currently Amended) A method as described in claim 12,  
wherein each of the downlink conventional channels of the first and of the further sets of  
time intervals are associated with one or more of the uplink conventional channels of the same  
respective set of time intervals, such that any remote communication device receiving data from  
its associated communication station during a first downlink conventional channel has first  
transmitted data to its associated communication station on an associated uplink conventional  
channel of its set of sequential time intervals,

wherein the first communication station knows the association of a downlink  
conventional channel and its one or more associated uplink conventional channels of the further  
sets,

wherein ~~the~~ receiving of the one or more uplink signals is includes receiving on uplink  
channels known to the first communication station to be the uplink channel associated with the  
first downlink channel on which the downlink message is to be transmitted, and

wherein ~~the~~ receiving of the one or more uplink signals is includes receiving the signals  
at the first communication station.

14. (Currently Amended) A method as described in claim 11 claim 1,  
wherein each of the downlink conventional channels of the first and of the further sets of  
time intervals are associated with one or more of the uplink conventional channels of the same  
respective set of time intervals, such that any remote communication device receiving data from  
its associated communication device station during a first downlink conventional channel has  
first transmitted data to its communication device station on an associated uplink conventional  
channel of its set of sequential time intervals,

wherein ~~the receiving step is~~ the one or more uplink signals includes receiving on one or more associated uplink channels known to the first communication station to be associated with the first downlink channel, and

wherein receiving ~~step~~ the one or more uplink signals includes receiving the one or more uplink signals from the one or more undesired remote communication devices at the first communication station.

15. (Original) A method as described in claim 14, wherein each of the selected number of downlink conventional channels is a distinct downlink data transfer period in the intervals of the first and any further sets, and wherein each associated uplink conventional channel is a distinct associated data transfer period of the intervals of the respective set of sequential time intervals, the associated data transfer periods being for uplink communication.

16. (Currently Amended) A method as described in ~~claim 11~~ claim 1, further comprising: forming side information about the undesired remote communication devices from the received one or more uplink signals;

storing the side information in a database in the first communication station; and retrieving the side information from the database,

wherein ~~the determining the downlink processing strategy determining step~~ includes using the retrieved side information as inputs.

17. (Currently Amended) A method as described in claim 16,

wherein ~~the receiving of~~ the one or more uplink signals is comprises receiving at the first communication station.

18. (Currently Amended) A method as described in claim 16,  
wherein the communication system includes ~~at least one other communication station~~  
~~and~~ an inter-communication-device communication mechanism,  
wherein ~~the~~ receiving of the one or more uplink signals includes receiving the signals at  
the one or more other communication stations,

wherein ~~the~~ forming the side information ~~step~~ for each undesired remote communication  
device occurs at the other communication station receiving the signal from said each undesired  
remote communication device, and

wherein the side information is communicated to the first communication station using  
the ~~inter-base-station~~ inter-communication-device communication mechanism.

19. (Currently Amended) A method as described in ~~claim 11~~ claim 1, wherein the first  
communication station includes at least a first remote communication device and a second  
remote communication device,

wherein ~~the received uplink signal~~ receiving the one or more uplink signals includes  
receiving a signal at the first communication station transmitted by the second remote  
communication device to the first communication station on a first associated uplink  
conventional channel associated with the first downlink conventional channel,

wherein the determining the downlink processing strategy determining step uses  
includes using the signal received from the second remote communication device as an input  
to determine the downlink processing strategy, and the determined downlink smart antenna  
processing strategy is to simultaneously

- (i) transmit data to the second remote communication device in a directional manner, and
- (ii) transmit a downlink message to the first remote communication device in a manner that

mitigates interference towards the second remote communication device on the first downlink conventional channel, and

wherein ~~the~~ transmitting step the downlink signal includes simultaneously transmitting data to the second remote communication device in a directional manner and the downlink message to the first remote communication device in a substantially non-directional manner that includes mitigating interference towards the second remote communication device.

20. (Currently Amended) A method as described in claim 19,

wherein each remote communication device has ~~an active a~~ state wherein it is in of active communication with its associated communication device station, and an idle state wherein ~~it~~ each remote communication device has established its identity but is not actively communicating with its communication device station, and

wherein the first remote communication device is in the idle state.

21. (Currently Amended) A method as described in claim 19,

wherein each of the downlink conventional channels is associated with one or more of the associated uplink conventional channels, such that any remote communication device receiving data from its communication device station during a first downlink conventional channel has ~~first~~ transmitted data to its communication device station on an associated uplink conventional channel;

wherein ~~said~~ receiving step the one or more uplink signals includes receiving one or more signals on the first associated uplink conventional channel, including receiving the signal transmitted by the second remote communication device device;

wherein the determining the downlink processing strategy determining uses includes using the one or more ~~received~~ uplink signals ~~received and received~~, the determined strategy is

to transmit on a downlink conventional channel associated with the first uplink conventional channel; and

wherein the simultaneously transmitting step is the data to the second remote communication device includes transmitting on a downlink conventional channel associated with and occurring later than the first associated uplink conventional channel; and channel.

~~wherein the first communication station-remote communication device is not transmitting to the first communication station on the first uplink conventional channel during the receiving step.~~

22. (Currently Amended) A method as described in claim 11 claim 1, wherein the determined determining the downlink processing strategy includes generating a strategy for transmitting the downlink signal in a direction wherefrom there were no substantial signals received on the uplink on the first uplink conventional channel in the receiving step.

23. (Currently Amended) A method as described in claim 22, wherein the determined determining the downlink processing strategy is determined from the includes compensating for a received signal covariance of the signals received in the receiving step.

24. (Currently Amended) A method as described in claim 19, wherein the determined determining the downlink processing strategy includes generating a strategy for transmitting the downlink message to the first remote communication device in a direction wherefrom there were no substantial signals received on the uplink on the first associated uplink conventional channel in the receiving step.

25. (Currently Amended) A method as described in claim 28 claim 24, wherein the determined determining the downlink processing strategy includes generating a strategy for transmitting the downlink message to the first remote communication device and the device.

determining the downlink processing strategy determining uses further including using a  
criterion from the received signal covariance of the signals received in the receiving step.

26. (Currently Amended) A method as described in claim 19, wherein ~~the determined~~  
determining the downlink processing strategy includes generating a strategy for transmitting  
the downlink message to the first remote communication ~~device and the device, determining~~  
the downlink processing strategy determining uses further including using a criterion that  
includes directing a null towards the second remote communication device.

27. (Original) A method as described in claim 20, wherein each of the selected number of  
downlink conventional channels is a distinct downlink data transfer period in the intervals of the  
set, and wherein each associated uplink conventional channel is a distinct associated data transfer  
period of the intervals of the set, the associated data transfer periods being for uplink  
communication.

28-30. (Canceled)

31. (Currently Amended) A method as described in claim 20,  
~~wherein the communication system includes a set of one or more other~~  
~~communication stations each having one or more remote communication devices,~~  
wherein the provided further sets of sequential time intervals ~~includes include~~ a set of  
sequential time intervals for each other communication station;  
wherein each downlink conventional channel of the further sets of sequential time  
intervals is associated with one or more of the associated uplink conventional channels,  
wherein each of the further sets of sequential time intervals is coordinated with the first  
set of sequential time intervals such that the first communication station knows the association

between a downlink conventional channel and an uplink conventional channel for each of the further sets,

wherein ~~the~~ receiving step the one or more uplink signals includes receiving signals at the first communication station on one or more associated uplink conventional channels of the further sets of sequential time intervals associated ~~with~~ with, and temporally preceding preceding, the downlink conventional channel of the further sets of sequential time intervals wherein the downlink transmitting step is to occur, and

wherein ~~the determined~~ determining the downlink processing strategy includes generating a strategy for transmitting the paging message to the first remote communication device in a manner that mitigates interference towards the second remote communication device and towards any remote communication devices of the other communication stations wherefrom signals are received on the associated uplink channels in the receiving step.

32. (Currently Amended) A first communication station comprising:

a smart antenna system to communicate with at least one remote communication device using a smart antenna processing strategy, the smart antenna system including a plurality of antenna elements;

an uplink reception unit, coupled to the antenna element plurality elements to provide an uplink conventional channel associated with each of a plurality of downlink conventional channels, each uplink conventional channel having a predefined relationship to its associated downlink conventional channel, and receive one or more uplink signals from one or more undesired remote communication devices on one or more uplink conventional channels associated with a first downlink conventional channel;

a processor, coupled to the uplink reception unit, the processor to determine a downlink smart antenna processing strategy for transmitting from the first communication station in a non-directional manner, the downlink processing strategy determining using the one or more received uplink signals, the strategy including mitigating to generate interference mitigation towards the one or more undesired remote communication devices known to be undesired, in <sup>one or more uplink conventional channels of</sup> that each of to reduce, with respect to the one or more undesired remote communication devices may receive one or more signals during transmitting devices, a strength of a signal <sup>as well as a downlink</sup> transmitted by the first communication station on the same conventional channel; and

a downlink transmission unit, coupled to the antenna element plurality elements and to the processor, to provide the first downlink conventional channel to transmit a downlink signal in a non-directional manner from the first communication station using the determined downlink processing strategy, provide a selected number of downlink conventional channels of a first set of sequential time intervals for the first communication station, the first set including the first downlink conventional channel, and provide one or more additional sets of sequential time intervals, each associated with one or more other communication stations for communication between the other communication stations and one or more remote communication devices associated with the other communication stations.

33. (Canceled)

34. (Currently Amended) A first communication station as described in claim 32, wherein the downlink signal is a paging signal to a first remote communication device of the first communication station, wherein each remote communication device associated with the first communication station has an active state wherein it is in active communication with the first communication

station, and an idle state wherein it has established its identity but is not actively communicating, and

wherein the first remote communication device is in an idle state during the transmitting step of the paging signal.

35. (Currently Amended) A first communication station as described in claim 32, wherein the downlink signal is a broadcast signal to one or more remote communication devices of the first communication station, and

wherein the processor determines the downlink strategy for transmitting the downlink signal in a substantially omnidirectional manner except for simultaneously mitigating interference towards the undesired remote communication devices.

36. (Original) A first communication station as described in claim 32, wherein the first communication station is coupled to an external data and/or voice network.

37. (Original) A first communication station as described in claim 36, wherein the external data and/or voice network includes the Internet.

38. (Original) A first communication station as described in claim 32, wherein the remote communication devices include a first remote user terminal.

39. (Original) A first communication station as described in claim 38, wherein the first remote user terminal is mobile.

40. (Original) A first communication station as described in claim 32, wherein the downlink data includes voice.

41. (Original) A first communication station as described in claim 32, wherein the downlink data includes information exchanged via the Internet.

42. (Currently Amended) A machine-readable medium having stored thereon information representing a set of machine-executable instructions, that, when executed by a machine, cause the machine to perform a method of transmitting a downlink signal from a first communication station of a communication system to a remote communication device, the first communication station having a smart antenna system, the method comprising:

providing a first set of sequential time intervals for the first communication station, each of the time intervals having a selected number of downlink conventional channels, and an associated conventional channel on an uplink conventional channel associated with each of the downlink conventional channels, each associated uplink conventional channel having a predefined relationship to its associated downlink conventional channel;

providing one or more further sets of sequential time intervals, each set of the one or more further sets of sequential time intervals associated with one or more other communication stations of the communication system, the further sets of sequential time intervals for communication between the other communication stations and one or more other remote communication devices associated with the other communication stations;

receiving one or more uplink signals from one or more of the other, undesired remote communication devices as interference on one or more uplink channels associated with a first downlink conventional channel;

determining a downlink smart antenna processing strategy for transmitting from the first communication station in a non-directional manner on ~~a~~ the first downlink conventional channel, the strategy including mitigating interference towards the one or more other remote communication devices ~~known to the first communication station to be undesired to reduce, with respect to in that each of~~ the one or more undesired remote communication devices

devices, a strength of a signal transmitted may receive one or more signals on the first downlink conventional channel during transmitting by the first communication station on the first downlink conventional channel, the downlink processing strategy using the received uplink signals as inputs to provide interference mitigation; and

transmitting a downlink signal in a non-directional manner from the first communication station on the first downlink conventional channel using the determined downlink processing strategy.

**43. (Currently Amended)** A machine-readable medium as described in claim 42, wherein the downlink signal is a paging signal to a first remote communication device of the first communication station,

wherein each remote communication device associated with the first communication station has an active state wherein it is in active communication with the first communication station, and an idle state wherein it has established its identity but is not actively communicating, and

wherein the first remote communication device is in an idle state during the transmitting step of the paging signal.

**44. (Original)** A machine-readable medium as described in claim 43, wherein the first remote communication device includes a second plurality of antenna elements.

**45. (Original)** A machine-readable medium as described in claim 44, wherein the first remote communication device includes a second smart antenna system that includes the second plurality of antenna elements.

**46. (Original)** A machine-readable medium as described in claim 43, wherein the remote communication devices include a first remote user terminal.

47. (Original) A machine-readable medium as described in claim 46, wherein the first remote user terminal is mobile.

48. (Currently Amended) A machine-readable medium as described in claim 42, wherein the downlink signal is a broadcast signal to one or more remote communication devices of the first communication station, and

wherein the downlink strategy determining step-determines the downlink processing strategy comprises determining a downlink smart antenna processing strategy for transmitting the downlink signal in a substantially omnidirectional manner except for simultaneously mitigating interference towards the undesired remote communication devices.

49. (Original) A machine-readable medium as described in claim 42, wherein the first communication station comprises a cellular base station.

50. (Original) A machine-readable medium as described in claim 42, wherein the first communication station is coupled to an external data and/or voice network.

51. (Original) A machine-readable medium as described in claim 50, wherein the external network includes the Internet.

52. (Canceled)

53. (Currently Amended) A method of transmitting a downlink signal in a non-directional manner from a first communication station having a smart antenna system on a first downlink conventional channel to a first remote communication device, while communicating with one or more other remote communication devices on the same first downlink conventional channel, the method comprising:

receiving one or more uplink signals from the other remote communication devices;

determining a downlink smart antenna processing strategy using the received uplink signals, the downlink processing strategy to be used to transmit from the first communication station in a non-directional manner on a the first downlink conventional channel channel, and to transmit to the one or more other remote communication devices on the same first downlink conventional channel; and

transmitting a first downlink signal in a non-directional manner from the first communication station station, and one or more other downlink signals to the one or more other remote communication devices devices, on the first downlink conventional channel using the determined downlink strategy, strategy;

providing a set of sequential time intervals for the first communication station, each of the time intervals having a selected number of downlink conventional channels including the first downlink conventional channel, and each of the downlink conventional channels further having an associated uplink conventional channel on the uplink associated with each of the downlink conventional channels in the time intervals, each associated uplink conventional channel having a predefined relationship to its associated the downlink conventional channel, channel; and

providing a set of further sequential time intervals associated with a different communication station, each of the further time intervals having a selected number of downlink conventional channels associated with the different communication station;

wherein the receiving the one or more uplink signals includes receiving on a first associated uplink channel associated with the first downlink conventional channel a second uplink signal from the second remote communication device transmitted at the first communication station, and

wherein the determining the downlink processing strategy determining uses includes using the received signals as an input to determine a downlink ~~smart antenna processing~~ strategy to simultaneously

(i) transmit downlink data to the second remote communication device in a directional manner, and (ii) transmit the first downlink signal to the first remote communication device in a manner that mitigates interference towards the second remote communication device on the first downlink conventional channel.

54. (Original) A method as described in claim 53, wherein the first communication station comprises a cellular base station.

55. (Original) A method as described in claim 53, wherein the first remote communication device includes a second plurality of antenna elements.

56. (Original) A method as described in claim 55, wherein the first remote communication device includes a second smart antenna system that includes the second plurality of antenna elements.

57. (Original) A method as described in claim 53, wherein the first communication station is coupled to an external data and/or voice network.

58. (Original) A method as described in claim 53, wherein the one or more other remote communication device include a first remote user terminal.

59. (Original) A method as described in claim 58, wherein the first remote user terminal is mobile.

60. (Original) A method as described in claim 53, wherein the first downlink signal includes voice.

61. (Original) A method as described in claim 53, wherein the first downlink signal includes information exchanged via the Internet.

62. (Cancelled)

63. (Currently Amended) A method as described in ~~claim 62~~ claim 53, wherein each remote communication device has ~~an active a state wherein it is in of~~ active communication with its associated communication device station, and an idle state wherein ~~it~~ each remote communication device has established its identity but is not actively communicating with its communication device station, and wherein the first remote communication device is in the idle state.

64. (Currently Amended) A method as described in ~~claim 62~~ claim 53, wherein each of the downlink conventional channels is associated with one or more of the uplink conventional channels, such that any remote communication device receiving data from its communication device during a first downlink conventional channel has ~~first~~ transmitted data to its communication device on an associated uplink conventional channel; and wherein the determining the downlink processing strategy determining uses includes using the one or more ~~received~~ uplink signals and received, the determined strategy is for transmitting on a ~~a~~ downlink conventional channel associated with and occurring later than the first associated uplink conventional channel, and channel.  
~~wherein the transmitting step is on a downlink conventional channel associated with the first associated uplink conventional channel; and~~  
~~wherein the first remote communication device is not transmitting to the first communication station on the first uplink conventional channel during the receiving step.~~

65. (Original) A method as described in claim 63, wherein each of the selected number of downlink conventional channels is a distinct downlink data transfer period in the intervals of the set, and wherein each associated uplink conventional channel is a distinct associated data transfer period of the intervals of the set, the associated data transfer periods being for uplink communication.

66. (Currently Amended) A method as described in claim 63, wherein ~~the determined smart antenna strategy determining the~~ downlink processing strategy ~~is~~ includes generating a strategy to transmit the first downlink signal in a direction wherefrom there were no substantial signals received on the uplink on the first associated uplink conventional channel in the receiving step.

67. (Currently Amended) A method as described in claim 66, wherein determining the downlink processing strategy ~~determining uses~~ includes using a criterion that is determined from the received signal covariance of the signals received in receiving step.

68. (Currently Amended) A method as described in claim 63, wherein determining the ~~determined smart antenna~~ downlink processing strategy includes generating a strategy to transmit the paging signal according to a criterion that includes directing nulls towards the second remote communication device.

69-91. (Canceled)